

09/980431

JC05 Rec'd PCT/PTO 30 NOV 2001

(Rel.82A—12/99 Pub.605)

FORM 13-18

13-159

**Practitioner's Docket No.** MEW087-100/011018**CHAPTER II**

Preliminary Classification:

Proposed Class:

Subclass:

**NOTE:** "All applicants are requested to include a preliminary classification on newly filed patent applications. The preliminary classification, preferably class and subclass designations, should be identified in the upper right-hand corner of the letter of transmittal accompanying the application papers, for example 'Proposed Class 2, subclass 129.' " M.P.E.P., § 601, 7th ed.

**TRANSMITTAL LETTER  
TO THE UNITED STATES ELECTED OFFICE (EO/US)**

**(ENTRY INTO U.S. NATIONAL PHASE UNDER CHAPTER II)**

PCT/GB00/02127	2 June 2000	4 June 1999
INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
Pilot Valve		
TITLE OF INVENTION		
Technolog Limited and Claude Yonnet (for US only)		
APPLICANT(S)		

Box PCT  
**Assistant Commissioner for Patents**  
 Washington, D.C. 20231 P.O. Box 2327, Arlington, VA 22202

ATTENTION: EO/US

**CERTIFICATION UNDER 37 C.F.R. § 1.10\***

(Express Mail label number is mandatory.)

(Express Mail certification is optional.)

I hereby certify that this Transmittal Letter and the papers indicated as being transmitted therewith is being deposited with the United States Postal Service on this date 11/30/01, in an envelope as "Express Mail Post Office to Addressee" Mailing Label Number EL 779651340US, addressed to the: Assistant Commissioner for Patents, Washington, D.C. 20231.

Amy Miles

(type or print name of person mailing paper)

Amy Miles

Signature of person mailing paper

**WARNING:** Certificate of mailing (first class) or facsimile transmission procedures of 37 C.F.R. § 1.8 cannot be used to obtain a date of mailing or transmission for this correspondence.

**\*WARNING:** Each paper or fee filed by "Express Mail" must have the number of the "Express Mail" mailing label placed thereon prior to mailing. 37 C.F.R. § 1.10(b).

"Since the filing of correspondence under § 1.10 without the Express Mail mailing label thereon is an oversight that can be avoided by the exercise of reasonable care, requests for waiver of this requirement will not be granted on petition." Notice of Oct. 24, 1996, 60 Fed. Reg. 56,439, at 56,442.

(Transmittal Letter to the United States Elected Office (EO/US) [13-18]—page 1 of 8)

**NOTE:** To avoid abandonment of the application, the applicant shall furnish to the USPTO, not later than 20 months from the priority date: (1) a copy of the international application, unless it has been previously communicated by the International Bureau or unless it was originally filed in the USPTO; and, (2) the basic national fee (see 37 C.F.R. § 1.492(a)). The 30-month time limit may be extended. 37 C.F.R. § 1.495.

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(TUE DEC 10 2001) 0 NOV 2001

**WARNING:** Where the items are those which can be submitted to complete the entry of the international application into the national phase are subsequent to 30 months from the priority date the application is still considered to be in the international state and if mailing procedures are utilized to obtain a date the express mail procedure of 37 C.F.R. § 1.10 must be used (since international application papers are not covered by an ordinary certificate of mailing—See 37 C.F.R. § 1.8).

**NOTE:** Documents and fees must be clearly identified as a submission to enter the national state under 35 U.S.C. § 371 otherwise the submission will be considered as being made under 35 U.S.C. § 111. 37 C.F.R. § 1.494(f).

- I. Applicant herewith submits to the United States Elected Office (EO/US) the following items under 35 U.S.C. § 371:
  - a.  This express request to immediately begin national examination procedures (35 U.S.C. § 371(f)).
  - b.  The U.S. National Fee (35 U.S.C. § 371(c)(1)) and other fees (37 C.F.R. § 1.492) as indicated below:

00000000000000000000000000000000

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## 2. Fees

CLAIMS FEE	(1) FOR	(2) NUMBER FILED	(3) NUMBER EXTRA	(4) RATE	(5) CALCULATIONS
<input type="checkbox"/> *	<b>TOTAL CLAIMS</b>	-20=		× \$18.00=	\$
	<b>INDEPENDENT CLAIMS</b>	-3=		× \$78.00=	
	<b>MULTIPLE DEPENDENT CLAIM(S) (if applicable)</b>				+ \$260.00
BASIC FEE**	<input type="checkbox"/> <b>U.S. PTO WAS INTERNATIONAL PRELIMINARY EXAMINATION AUTHORITY</b> Where an International preliminary examination fee as set forth in § 1.482 has been paid on the international application to the U.S. PTO: <ul style="list-style-type: none"> <li><input type="checkbox"/> and the international preliminary examination report states that the criteria of novelty, inventive step (non-obviousness) and industrial activity, as defined in PCT Article 33(1) to (4) have been satisfied for all the claims presented in the application entering the national stage (37 C.F.R. § 1.492(a)(4)) ..... \$96.00</li> <li><input type="checkbox"/> and the above requirements are not met (37 C.F.R. § 1.492(a)(1)) ..... \$670.00</li> </ul> <b>XXX U.S. PTO WAS NOT INTERNATIONAL PRELIMINARY EXAMINATION AUTHORITY</b> Where no international preliminary examination fee as set forth in § 1.482 has been paid to the U.S. PTO, and payment of an international search fee as set forth in § 1.445(a)(2) to the U.S. PTO: <ul style="list-style-type: none"> <li><input type="checkbox"/> has been paid (37 C.F.R. § 1.492(a)(2)) ..... \$690.00</li> <li><input type="checkbox"/> has not been paid (37 C.F.R. § 1.492(a)(3)) ..... \$970.00</li> </ul> <b>XXX where a search report on the international application has been prepared by the European Patent Office or the Japanese Patent Office (37 C.F.R. § 1.492(a)(5)) ..... \$840.00</b>				
	<b>Total of above Calculations</b>				= 890.00
SMALL ENTITY	<b>Reduction by 1/2 for filing by small entity, if applicable. Affidavit must be filed also. (note 37 C.F.R. § 1.9, 1.27, 1.28)</b>				-
	<b>Subtotal</b>				890.00
	<b>Total National Fee</b>				\$890.00
	<b>Fee for recording the enclosed assignment document \$40.00 (37 C.F.R. § 1.21(h)). (See Item 13 below). See attached "ASSIGNMENT COVER SHEET".</b>				
<b>TOTAL</b>	<b>Total Fees enclosed</b>				<b>\$ 890.00</b>

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- i.  A check in the amount of 890.00 to cover the ~~100~~ fees is enclosed.
- ii.  Please charge Account No. \_\_\_\_\_ in the amount of \$ \_\_\_\_\_.  
A duplicate copy of this sheet is enclosed.

**WARNING:** "To avoid abandonment of the application the applicant shall furnish to the United States Patent and Trademark Office not later than the expiration of 30 months from the priority date: \*\*\* (2) the basic national fee (see § 1.492(a)). The 30-month time limit may not be extended." 37 C.F.R. § 1.495(b).

**WARNING:** If the translation of the international application and/or the oath or declaration have not been submitted by the applicant within thirty (30) months from the priority date, such requirements may be met within a time period set by the Office. 37 C.F.R. § 1.495(b)(2). The payment of the surcharge set forth in § 1.492(e) is required as a condition for accepting the oath or declaration later than thirty (30) months after the priority date. The payment of the processing fee set forth in § 1.492(f) is required for acceptance of an English translation later than thirty (30) months after the priority date. Failure to comply with these requirements will result in abandonment of the application. The provisions of § 1.136 apply to the period which is set. Notice of Jan. 3, 1993, 1147 O.G. 29 to 40.

3.  A copy of the International application as filed (35 U.S.C. § 371(c)(2)):

**NOTE:** Section 1.495 (b) was amended to require that the basic national fee and a copy of the international application must be filed with the Office by 30 months from the priority date to avoid abandonment. "The International Bureau normally provides the copy of the international application to the Office in accordance with PCT Article 20. At the same time, the International Bureau notifies applicant of the communication to the Office. In accordance with PCT Rule 47.1, that notice shall be accepted by all designated offices as conclusive evidence that the communication has duly taken place. Thus, if the applicant desires to enter the national stage, the applicant normally need only check to be sure the notice from the International Bureau has been received and then pay the basic national fee by 30 months from the priority date." Notice of Jan. 7, 1993, 1147 O.G. 29 to 40, at 35-36. See item 14c below.

- a.  is transmitted herewith.
- b.  is not required, as the application was filed with the United States Receiving Office.
- c.  has been transmitted
  - i.  by the International Bureau.
  - Date of mailing of the application (from form PCT/1B/308): 14 Dec., 2000
  - ii.  by applicant on \_\_\_\_\_  
    Date

4.  A translation of the International application into the English language (35 U.S.C. § 371(c)(2)):

- a.  is transmitted herewith.
- b.  is not required as the application was filed in English.
- c.  was previously transmitted by applicant on \_\_\_\_\_  
    Date
- d.  will follow.

(Transmittal Letter to the United States Elected Office (EO/US) [13-18]—page 4 of 8)

**5.  Amendments to the claims of the International application under PCT Article 19 (35 U.S.C. § 371(c)(3)):**

NOTE: *The Notice of January 7, 1993 points out that 37 C.F.R. § 1.495(a) was amended to clarify the existing and continuing practice that PCT Article 19 amendments must be submitted by 30 months from the priority date and this deadline may not be extended. The Notice further advises that: "The failure to do so will not result in loss of the subject matter of the PCT Article 19 amendments. Applicant may submit that subject matter in a preliminary amendment filed under section 1.121. In many cases, filing an amendment under section 1.121 is preferable since grammatical or idiomatic errors may be corrected." 1147 O.G. 29-40, at 36.*

a.  are transmitted herewith.

b.  have been transmitted

i.  by the International Bureau.

Date of mailing of the amendment (from form PCT/1B/308): \_\_\_\_\_

ii.  by applicant on (date) \_\_\_\_\_

Date

c.  have not been transmitted as

i.  applicant chose not to make amendments under PCT Article 19.

Date of mailing of Search Report (from form PCT/ISA/210.): 26 Sept. 2000

ii.  the time limit for the submission of amendments has not yet expired.

The amendments or a statement that amendments have not been made will be transmitted before the expiration of the time limit under PCT Rule 46.1.

**6.  A translation of the amendments to the claims under PCT Article 19**

(38 U.S.C. § 371(c)(3)):

a.  is transmitted herewith.

b.  is not required as the amendments were made in the English language.

c.  has not been transmitted for reasons indicated at point 5(c) above.

**7.  A copy of the international examination report (PCT/IPEA/409)**

is transmitted herewith.

is not required as the application was filed with the United States Receiving Office.

**8.  Annex(es) to the international preliminary examination report**

a.  is/are transmitted herewith.

b.  is/are not required as the application was filed with the United States Receiving Office.

**9.  A translation of the annexes to the international preliminary examination report**

a.  is transmitted herewith.

b.  is not required as the annexes are in the English language.

10.  An oath or declaration of the inventor (35 U.S.C. § 371(c)(4)) complying with  
35 U.S.C. § 115

- a.  was previously submitted by applicant on 09/980431  
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Date
- b.  is submitted herewith, and such oath or declaration  
i.  is attached to the application.
- ii.  identifies the application and any amendments under PCT Article  
19 that were transmitted as stated in points 3(b) or 3(c) and 5(b); and  
states that they were reviewed by the inventor as required by  
37 C.F.R. § 1.70.
- c.  will follow.

II. Other document(s) or information included:

11.  An International Search Report (PCT/ISA/210) or Declaration under  
PCT Article 17(2)(a):

- a.  is transmitted herewith.
- b.  has been transmitted by the International Bureau.  
Date of mailing (from form PCT/IB/308): \_\_\_\_\_
- c.  is not required, as the application was searched by the United States  
International Searching Authority.
- d.  will be transmitted promptly upon request.
- e.  has been submitted by applicant on \_\_\_\_\_

Date

12.  An Information Disclosure Statement under 37 C.F.R. §§ 1.97 and 1.98:

- a.  is transmitted herewith.

Also transmitted herewith is/are:

Form PTO-1449 (PTO/SB/08A and 08B).

Copies of citations listed.

- b.  will be transmitted within THREE MONTHS of the date of submission  
of requirements under 35 U.S.C. § 371(c).
- c.  was previously submitted by applicant on \_\_\_\_\_

Date

13.  An assignment document ~~is transmitted herewith~~ for recording.

A separate  "COVER SHEET FOR ASSIGNMENT (DOCUMENT) ACCOMPANYING NEW PATENT APPLICATION" or  FORM PTO 1595 is also attached.

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(Transmittal Letter to the United States Elected Office (EO/US) [13-18]—page 6 of 8)

14.  Additional documents:

- a.  Copy of request (PCT/RO/101)
- b.  International Publication No. WO 00/75741 A1
  - i.  Specification, claims and drawing
  - ii.  Front page only
- c.  Preliminary amendment (37 C.F.R. § 1.121)
- d.  Other

Form PCT/IB/304; Form PCT/IB/301; Form PCT/IB/308

Written Opinion

15.  The above checked items are being transmitted

- a.  before 30 months from any claimed priority date.
- b.  after 30 months.

16.  Certain requirements under 35 U.S.C. § 371 were previously submitted by the applicant on \_\_\_\_\_, namely:

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**AUTHORIZATION TO CHARGE ADDITIONAL FEES**

**WARNING:** Accurately count claims, especially multiple defendant claims, to avoid unexpected high charges if extra claims are authorized.

**NOTE:** "A written request may be submitted in an application that is an authorization to treat any concurrent or future reply, requiring a petition for an extension of time under this paragraph for its timely submission, as incorporating a petition for extension of time for the appropriate length of time. An authorization to charge all required fees, fees under § 1.17, or all required extension of time fees will be treated as a constructive petition for an extension of time in any concurrent or future reply requiring a petition for an extension of time under this paragraph for its timely submission. Submission of the fee set forth in § 1.17(a) will also be treated as a constructive petition for an extension of time in any concurrent reply requiring a petition for an extension of time under this paragraph for its timely submission." 37 C.F.R. § 1.136(a)(3).

**NOTE:** "Amounts of twenty-five dollars or less will not be returned unless specifically requested within a reasonable time, nor will the payer be notified of such amounts; amounts over twenty-five dollars may be returned by check or, if requested, by credit to a deposit account." 37 C.F.R. § 1.26(a).

The Commissioner is hereby authorized to charge the following additional fees that may be required by this paper and during the entire pendency of this application to Account No. 08-1500

37 C.F.R. § 1.492(a)(1), (2), (3), and (4) (filing fees)

**WARNING:** Because failure to pay the national fee within 30 months without extension (37 C.F.R. § 1.495(b)(2)) results in abandonment of the application, it would be best to always check the above box.

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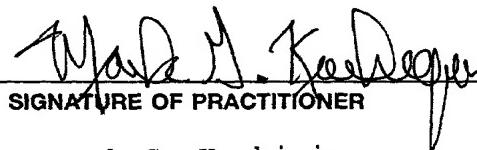
 37 C.F.R. § 1.492(b), (c) and (d) (presentation of extra claims)

**NOTE:** Because additional fees for excess or multiple dependent claims not paid on time at the time of presentation must only be paid on these claims cancelled by amendment prior to the expiration of the time period set for response by the PTO in any notice of fee deficiency (37 C.F.R. § 1.492(d)), it might be best not to authorize the PTO to charge additional claim fees, except possible when dealing with amendments after final action.

 37 C.F.R. § 1.17 (application processing fees) 37 C.F.R. § 1.17(a)(1)-(5) (extension fees pursuant to § 1.136(a)). 37 C.F.R. § 1.18 (issue fee at or before mailing of Notice of Allowance, pursuant to 37 C.F.R. § 1.311(b))

**NOTE:** Where an authorization to charge the issue fee to a deposit account has been filed before the mailing of a Notice of Allowance, the issue fee will be automatically charged to the deposit account at the time of mailing the notice of allowance. 37 C.F.R. § 1.311(b).

**NOTE:** 37 C.F.R. § 1.28(b) requires "Notification of any change in loss of entitlement to small entity status must be filed in the application . . . prior to paying, or at the time of paying . . . issue fee." From the wording of 37 C.F.R. § 1.28(b): (a) notification of change of status must be made even if the fee is paid as "other than a small entity" and (b) no notification is required if the change is to another small entity.

 37 C.F.R. § 1.492(e) and (f) (surcharge fees for filing the declaration and/or filing an English translation of an International Application later than 30 months after the priority date).


**SIGNATURE OF PRACTITIONER**

Reg. No.: 32,840

Tel. No.: (918) 587-2000

Customer No.: 24,118

Mark G. Kachigian(type or print name of practitioner)  
228 West 17th Place

P.O. Address

Tulsa, OK 74119

(Transmittal Letter to the United States Elected Office (EO/US) [13-18]—page 8 of 8)

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Application No.: Unknown )  
Filing Date: Unknown )  
Priority Date: 4 December 2000 )  
Applicants: YONNET, Claude )  
For: PILOT VALVE )

**PRELIMINARY AMENDMENT**

Director For Patents  
Box: New Application  
Washington, D.C. 20231

Dear Sir:

This is a preliminary amendment to the enclosed application entitled "Pilot Valve" claiming priority to PCT Application No. PCT/GB00/02127 filed 2 June 2000, which claims priority to British Application No. 9913058.5 filed 4 June 1999.

**In the Specification:**

Please amend the specification as published on 14 December 2000 under No. WO 00/75741A1 as follows:

Page 1, after the title, insert the following headers and paragraph:

**--CROSS-REFERENCE TO RELATED APPLICATION**

This application claims priority to PCT Application No. PCT/GB00/02127 filed 2 June 2000, which claims priority to British Application No. 9913058.5 filed 4 June 1999.

**BACKGROUND OF THE INVENTION-**

Page 6, before line 16, insert the Header:

**--SUMMARY OF THE INVENTION--**

Page 8, before line 22 insert the following header:

**--BRIEF DESCRIPTION OF THE DRAWINGS--**

Page 9, before line 11, add the Header:

**--DESCRIPTION OF THE PREFERRED EMBODIMENTS--**

Please amend the claims as they appear in the Preliminary Examination Report dated 03.09.2001 and as originally filed as follows:

**IN THE CLAIMS:**

1. (Amended) A pilot valve for use in a water supply system, said valve comprising: [including]

    biasing means to control a gate for controlling water flow through a control chamber; a second chamber sealed by a second chamber diaphragm into which control pressure is applicable for also controlling the operation of the gate, whereby, in use, an increase in control pressure acts to reduce water flow through the gate; and

    wherein the side of the diaphragm against which the control pressure is not applied, is in fluid communication with the control chamber.

2. (Amended) A pilot valve according to claim 1 wherein [the] said biasing means is biased to open [the] said gate.

3. (Amended) A pilot valve according to claim 2 wherein [the] said biasing means is rigidly connected to [the] said gate by a mechanical linkage.

5. (Amended) A pilot valve according to claim 3 [or claim 4] wherein the diaphragm is rigidly connected to said biasing means via a mechanical linkage.
6. (Amended) A pilot valve according to [any one of the preceding] claim[s] 1 wherein [the] said biasing means is a spring means.
7. (Amended) A pilot valve according to claim 6 wherein [the] said spring means is a helical spring.
8. (Amended) A pilot valve according to [any one of the preceding] claim[s] 1 further including a control chamber diaphragm.
9. (Amended) A pilot valve according to claim 8 wherein said biasing means is located on the opposite side of [the] said control chamber diaphragm to [the] said control chamber.
10. (Amended) A pilot valve according to [any one of] claim[s] 8 [or 9] wherein the ratio of the area of [the] said control chamber diagram to [the] said second chamber diaphragm is 2:1 or less.
11. (New) A pilot valve for use in a water supply system, said valve comprising:  
biasing means to control a gate for controlling water flow through a control chamber;  
a second chamber sealed by a second chamber diaphragm into which control

pressure is applicable for also controlling the operation of the gate, whereby, in use, an increase in control pressure acts to reduce water flow through the gate;

wherein the side of the diaphragm against which the control pressure is not applied, is in fluid communication with the control chamber;

wherein the biasing means is biased to open the gate and is rigidly connected to the gate by a mechanical linkage;

wherein the diaphragm is rigidly connected to the gate and the biasing means by a mechanical linkage; and

further including a control chamber diaphragm wherein said biasing means is located on the opposite side of the control chamber diaphragm to the control chamber.

#### REMARKS

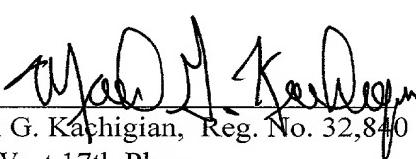
Attached is the clean version of the claims and new paragraphs as required in Section 1.121(4) (ii).

The application should now be in condition for examination, which is respectfully requested.

Respectfully Submitted

HEAD, JOHNSON & KACHIGIAN

Dated: 30 November 2001

BY:   
Mark G. Kachigian, Reg. No. 32,840  
228 West 17th Place  
Tulsa, Oklahoma 74119  
(918) 584-4187  
Attorneys for Applicant

New Header to be Inserted on Page 1, before line 1:

**--CROSS-REFERENCE TO RELATED APPLICATION**

This application claims priority to PCT Application No. PCT/GB00/02127 filed 2 June 2000 which claims priority to British Patent Application No. 9913058.5 filed 04 June 1999

**BACKGROUND OF THE INVENTION**

Header to be inserted into Page 6

## SUMMARY OF THE INVENTION

Header to be Inserted into Page 8

BRIEF DESCRIPTION OF THE DRAWINGS

Header to be Inserted into Page 9

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

## Clean Version of the Claims

1. (Amended) A pilot valve for use in a water supply system, said valve comprising:  
biasing means to control a gate for controlling water flow through a control chamber;  
a second chamber sealed by a second chamber diaphragm into which control pressure is  
applicable for also controlling the operation of the gate, whereby, in use, an increase in control  
pressure acts to reduce water flow through the gate; and  
wherein the side of the diaphragm against which the control pressure is not applied, is in  
fluid communication with the control chamber.
2. (Amended) A pilot valve according to claim 1 wherein said biasing means is biased to  
open said gate.
3. (Amended) A pilot valve according to claim 2 wherein said biasing means is rigidly  
connected to said gate by a mechanical linkage.
5. (Amended) A pilot valve according to claim 3 wherein the diaphragm is rigidly  
connected to said biasing means via a mechanical linkage.
6. (Amended) A pilot valve according to claim 1 wherein said biasing means is a spring  
means.
7. (Amended) A pilot valve according to claim 6 wherein said spring means is a helical  
spring.

8. (Amended) A pilot valve according to claim 1 further including a control chamber diaphragm.

9. (Amended) A pilot valve according to claim 8 wherein said biasing means is located on the opposite side of said control chamber diaphragm to said control chamber.

10. (Amended) A pilot valve according to claim 8 wherein the ratio of the area of said control chamber diaphragm to said second chamber diaphragm is 2:1 or less.

11. (New) A pilot valve for use in a water supply system, said valve comprising:  
biasing means to control a gate for controlling water flow through a control chamber;

a second chamber sealed by a second chamber diaphragm into which control pressure is applicable for also controlling the operation of the gate, whereby, in use, an increase in control pressure acts to reduce water flow through the gate;

wherein the side of the diaphragm against which the control pressure is not applied, is in fluid communication with the control chamber;

wherein the biasing means is biased to open the gate and is rigidly connected to the gate by a mechanical linkage;

wherein the diaphragm is rigidly connected to the gate and the biasing means by a mechanical linkage; and

further including a control chamber diaphragm

wherein said biasing means is located on the opposite side of the control chamber diaphragm to the control chamber.

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PILOT VALVE

The present invention relates to a pilot valve, for example of the type which is commonly used to control a pressure reducing valve in water and gas supply systems.

Figure 1 illustrates the use of a "single chamber" pilot valve 1 to control a pressure reducing valve (PRV - shown schematically as item 2) as commonly used in a water supply system. In the context of a gas supply system such a pressure reducing valve is normally known as a "regulator" or "governor", but herein the single term "PRV" is used for simplicity as referring to both types of system. The fluid to be controlled (usually water or gas, and in this example will be taken to be water) flows along the main pipe 3 through the PRV. The outlet pressure ( $P_o$ ) is usually less than the inlet pressure ( $P_i$ ) due to the action of the PRV.

\*20 The amount of pressure reduction is controlled by operation of the PRV under control of pilot valve 1. An auxiliary flow pipe 4 carries water from the inlet of the PRV to the control chamber 5 of the pilot valve 1 and then back to the outlet of the PRV. Prior to entering the control chamber 5, the water passes through a venturi chamber (or primary orifice) 6 or, more correctly in the context of a gas supply system, an inspirator 6 and the

202/220 "F21703660

water pressure ( $P_v$ ) at the outlet side 7 of the chamber or inspirator controls the PRV.

The flow of water through the control chamber 5 is controlled by a gate mechanism 8 which is linked to a diaphragm 9. A spring 10 applies force to the rear of the diaphragm 9 and the amount of force supplied by the spring may be varied by an adjustment screw 11.

In a steady state situation (where  $P_o$  remains constant) the water pressure in the control chamber 5 will be balanced by the force generated the spring and the gate 8 will remain in a constant position. Thus the flow through the auxiliary pipe 4 will remain constant and  $P_v$  will remain constant.

If the control pressure ( $P_o$ ) falls, the spring 10 causes the gate 8 to open further and the flow through the auxiliary pipe increases. Accordingly, the flow through the venturi 6 also increases which results in pressure  $P_v$  decreasing, causing the PRV to open further. This results in the control pressure  $P_o$  rising again and the system should then reach a steady state again at the previously set value of  $P_o$ .

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In order to provide an improved control system, the present applicant has already disclosed a system which

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uses a "dual chamber" pilot valve in European Patent No. 574241. Figure 2 shows an example of a system utilising a "sandwich plate" dual chamber pilot 20. The pilot valve 20 performs the same general function in the control 5 system as the pilot valve of Figure 1 but in this example the adjustment previously provided by adjustment screw 11 is effectively supplemented by an adjustment using a control pressure ( $P_c$ ). As further relevant background art may be mentioned the gas supply pressure control apparatus 10 as disclosed by the present applicant in GB-A-2252848.

The pilot valve 20 includes a second chamber 21 which is effectively divided into two portions 22 and 23 by a wall 24. The control pressure  $P_c$  effectively acts against 15 the force of spring 10 by virtue of diaphragm 26. As with Figure 1, the spring is mechanically connected by arm 28 to a gate mechanism 8 which performs the same function as previously. The arm 28 passes through wall 24 and the aperture through which it passes is sealed by a seal 29 so 20 that chamber 23 does not contain any water but instead is vented to the atmosphere.

If the control pressure  $P_c$  remains constant, then the system operates as explained with reference to Figure 1. 25 However, if the control pressure  $P_c$  is reduced then the gate 8 will open further thereby reducing pressure  $P_v$  and increasing the outlet pressure  $P_o$ . This is usually

referred to as a "failsafe" system since in the event that the control pressure fails i.e. falls to zero, the outlet pressure  $P_o$  will be set to its maximum value.

5       Figure 3 illustrates an alternative but mechanically equivalent "dual chamber" pilot valve arrangement to that shown in Figure 2. The arrangement of Figure 3 is sometimes referred to as a "pancake adapted" pilot. In this arrangement, the second chamber 31 is located at the  
10 base of the pilot 30. As with the arrangement of Figure 2, the second chamber 31 is divided by a diaphragm 34 into two chambers 32 and 33 and the control pressure  $P_c$  is applied to chamber 32. The diaphragm 34 is mechanically linked via an arm 35 to the gate mechanism 8 but is not  
15 rigidly limited to the gate or spring. The arm 35 presses into control chamber 5 via an aperture which is again sealed with seal 36.

In the embodiment of Figure 3, the control pressure  
20  $P_c$  again opposes the force produced by the spring 10 and so the control system effectively operates in an identical manner. In other words, if control pressure  $P_c$  is reduced then the outlet pressure  $P_o$  is increased.

25       One advantage over the Figure 3 arrangement as opposed to the Figure 2 arrangement is that the additional chamber 31 can effectively be retrofitted to a single

chamber pilot valve. However one disadvantage with the dual chamber pilot valves of Figures 2 and 3 is that in both cases a seal needs to be provided in order that the control fluid is prevented from entering the second part 5 of the additional chamber i.e. that part of the chamber to which the control pressure is not applied. The provision of such a seal can be difficult and deterioration or failure of the seal may lead to reduction in performance of the pilot valve or leakage therefrom. Furthermore, the 10 friction caused by the seal can in turn create a frictional error in the quality of the pilot valve control.

Figure 4 shows a further "hydraulic" dual chamber 15 pilot valve arrangement. As with the previous embodiments, a second chamber 40 is provided which is divided by a diaphragm 41 into two parts 42 and 43. The control pressure  $P_c$  is applied to part 42 of the second chamber 40 and part 43 is connected to the spring chamber 20 which is vented to the atmosphere. As before, the diaphragm 41 is mechanically connected to the gate 8, in this case via the spring 10.

However, unlike the embodiments of Figure 2 and 25 Figure 3 in the embodiment of Figure 4 the control pressure  $P_c$  acts in the same direction as the force of the spring 10, rather than against it. This means that the

control system works in the opposite way to that of Figures 2 and 3 i.e. if the control pressure  $P_c$  is reduced then the gate 8 closes further, the venturi pressure  $P_v$  increases causing the PRV to close further and the outlet pressure to drop. This arrangement is not considered to be "failsafe" since a loss of control pressure  $P_c$  would result in the lowest possible outlet pressure  $P_o$ . This is sometimes referred to as a "direct acting" control system rather than the "reverse acting" control systems of Figures 2 and 3.

The present invention aims to provide a pilot valve of the "reverse acting" type but which eliminates the need for a seal.

15

In a first aspect, the present invention provides a pilot valve which includes

biasing means to control a gate for controlling fluid flow through a control chamber;

20 a second chamber sealed by a second chamber diaphragm into which control pressure is applicable for also controlling the operation of the gate, whereby in use an increase in control pressure acts to reduce fluid flow through the gate;

25 wherein the side of the diaphragm against which the control pressure is not applied is in fluid communication with the control chamber.

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In this way, a "reverse acting" dual chamber pilot valve is provided in which the need for any seal in association with the second chamber is avoided.

5       The fluid which in use flows through the control chamber may or may not be the same fluid or type of fluid as the fluid which in use is used to apply the control pressure. The fluids in question may, for example, be water or gas. In other words, in one example both fluids  
10 in question may be water; in another example both fluids may be gas; in a third example one fluid may be water and the other gas.

Preferably, the biassing means is a spring means or  
15 spring such as a helical spring. Preferably the biassing means is biassed to open the gate and may be rigidly connected to the gate by a suitable mechanical linkage. Preferably the diaphragm is also rigidly connected to the gate and/or biassing means via the same or a second  
20 suitable mechanical linkage.

Preferably, the control chamber is at least partly bounded by a control chamber diaphragm in addition to the second chamber diaphragm. Preferably biassing means is  
25 located on the opposite side of the control chamber diaphragm to the control chamber. As will be explained in detail later in the specification, by appropriately

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selecting the areas of the second chamber diaphragm and the control chamber diaphragm, the effect of the control pressure on the fluid flow through the control chamber (and therefore in use, on the outlet pressure) can be  
5 selected.

In a preferred embodiment, the ratio of the area of the control chamber diaphragm to the second chamber diaphragm is 2:1 or less. For example, if the control  
10 chamber diaphragm is twice the area of the second chamber diaphragm then a particular drop in control pressure will result in an identical increase in outlet pressure. In a different example, if the area of the second chamber diaphragm is three-quarters that of the control chamber  
15 diaphragm then an increase in control pressure of a given amount would cause the outlet pressure to decrease by three times that amount. The particular case in which the second chamber diaphragm area is half that of the control chamber diaphragm effectively replicates the function of  
20 the "sandwich" and "pancake" arrangements described earlier with reference to Figures 2 and 3.

Embodiments of the present invention will now be described by way of example with reference to the  
25 accompanying drawings in which:

Figure 1 is a schematic diagram of a single chamber

pilot valve control arrangement;

Figure 2 is a schematic diagram of a "sandwich" dual chamber pilot valve arrangement;

Figure 3 is a schematic diagram of a "pancake" dual 5 chamber pilot valve arrangement;

Figure 4 is a schematic diagram of a "hydraulic" dual chamber pilot valve arrangement; and

Figure 5 is a schematic diagram of a pilot valve according to an embodiment of the present invention.

10

Figure 5 shows a pilot valve 50 which includes a control chamber 51 and a second chamber 52. A control pressure  $P_c$  is applied to chamber 52 in use and chamber 52 is divided from control chamber 51 by a second chamber 15 diaphragm 53.

The second chamber diaphragm 53 is rigidly connected via linkage 54 to a gate mechanism 55. The gate mechanism 55 is also connected via a further rigid linkage 56 to a 20 spring 57. The spring 57 is isolated from the control chamber 51 by the control chamber diaphragm 58. The action of the force of the spring 57 on the diaphragm 58 may be adjusted by adjustment screw 59.

25 As can be seen from Figure 5, the control fluid (which may be gas or water) present in the control chamber 51 acts against the opposite side of the second chamber

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diaphragm 53 to the control pressure  $P_c$ . In operation, if, for example, control pressure  $P_c$  is reduced then the gate 55 will open further causing the fluid flow through the control chamber to increase. When used in a PRV 5 control circuit, as explained previously, this will cause the outlet pressure to increase.

As indicated in Figure 5, the area of the control chamber diaphragm 53 is designated A and the area of the 10 second chamber diaphragm 53 is designated as  $A'$ . The balance of forces operating in the pilot valve is as follows:

$$\begin{aligned} SF &= AP_o - A' P_o + A' P_c \\ 15 \quad &= (A-A') P_o + A' P_c \end{aligned}$$

In a first example, if  $A' = \frac{1}{2}A$

$$\begin{aligned} SF &= A' (P_o + P_c) \\ 20 \quad & \end{aligned}$$

If a "multiplication" effect is required then the relative cross-section areas can be set to a different value. In a second example, if  $A' = 3/4 A$ , the equation will be

$$25 \quad SF = \frac{1}{4} A (P_o + 3P_c)$$

Therefore an increase of  $P_c$  of a given amount would

cause  $P_0$  to decrease by three times the amount and vice versa.

The above embodiment is given by way of example only  
5 and variations will be apparent to those skilled in the  
art.

Claims

1. A pilot valve for use in a water supply system including

biassing means to control a gate for controlling water flow through a control chamber;

a second chamber sealed by a second chamber diaphragm into which control pressure is applicable for also controlling the operation of the gate, whereby, in use, an increase in control pressure acts to reduce water flow through the gate;

wherein the side of the diaphragm against which the control pressure is not applied, is in fluid communication with the control chamber.

2. A pilot valve according to claim 1 wherein the biassing means is biassed to open the gate.

3. A pilot valve according to claim 2 wherein the biassing means is rigidly connected to the gate by a mechanical linkage.

4. A pilot valve according to claim 3 wherein the diaphragm is rigidly connected to the gate by a mechanical linkage.

5. A pilot valve according to claim 3 or claim 4

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means via a mechanical linkage.

6. A pilot valve according to any one of the preceding claims wherein the biasing means is a spring means.

5

7. A pilot valve according to claim 6 wherein the spring means is a helical spring.

8. A pilot valve according to any one of the preceding  
10 claims further including a control chamber diaphragm.

9. A pilot valve according to claim 8 wherein said biasing means is located on the opposite side of the control chamber diaphragm to the control chamber.

15

10. A pilot valve according to any one of claims 8 or 9 wherein the ratio of the area of the control chamber diaphragm to the second chamber diaphragm is 2:1 or less.

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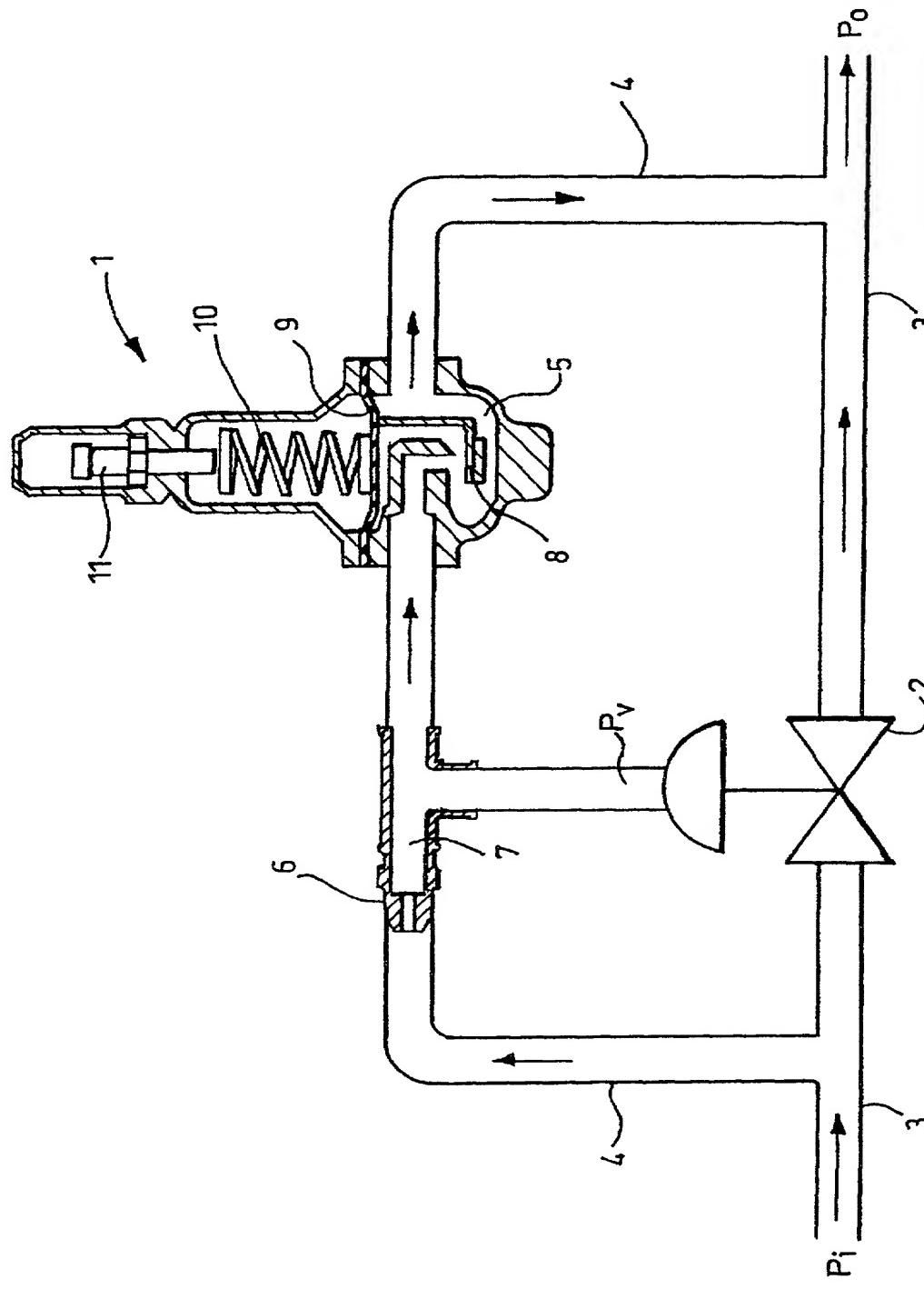


FIG.1.

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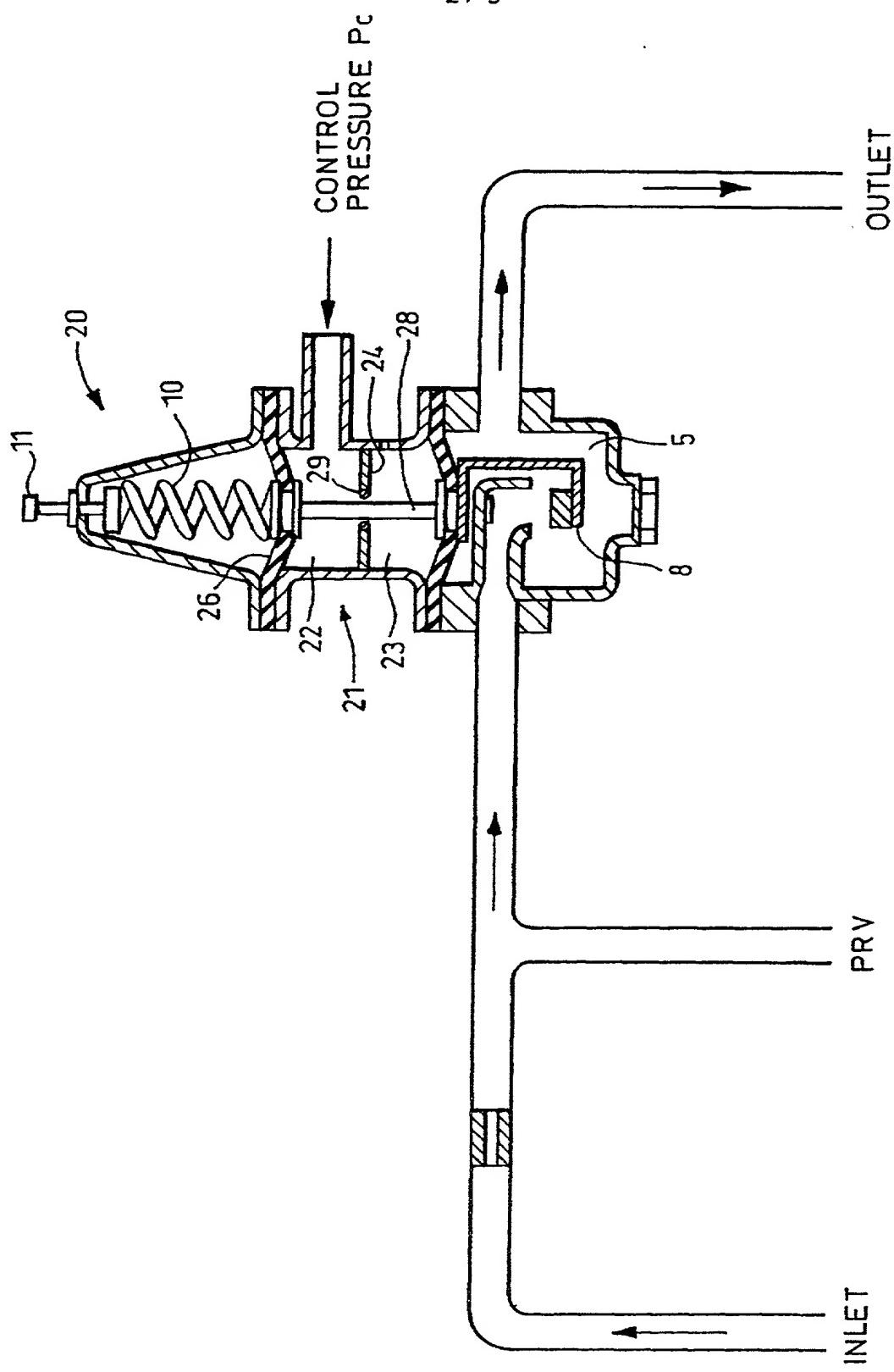


FIG.2.

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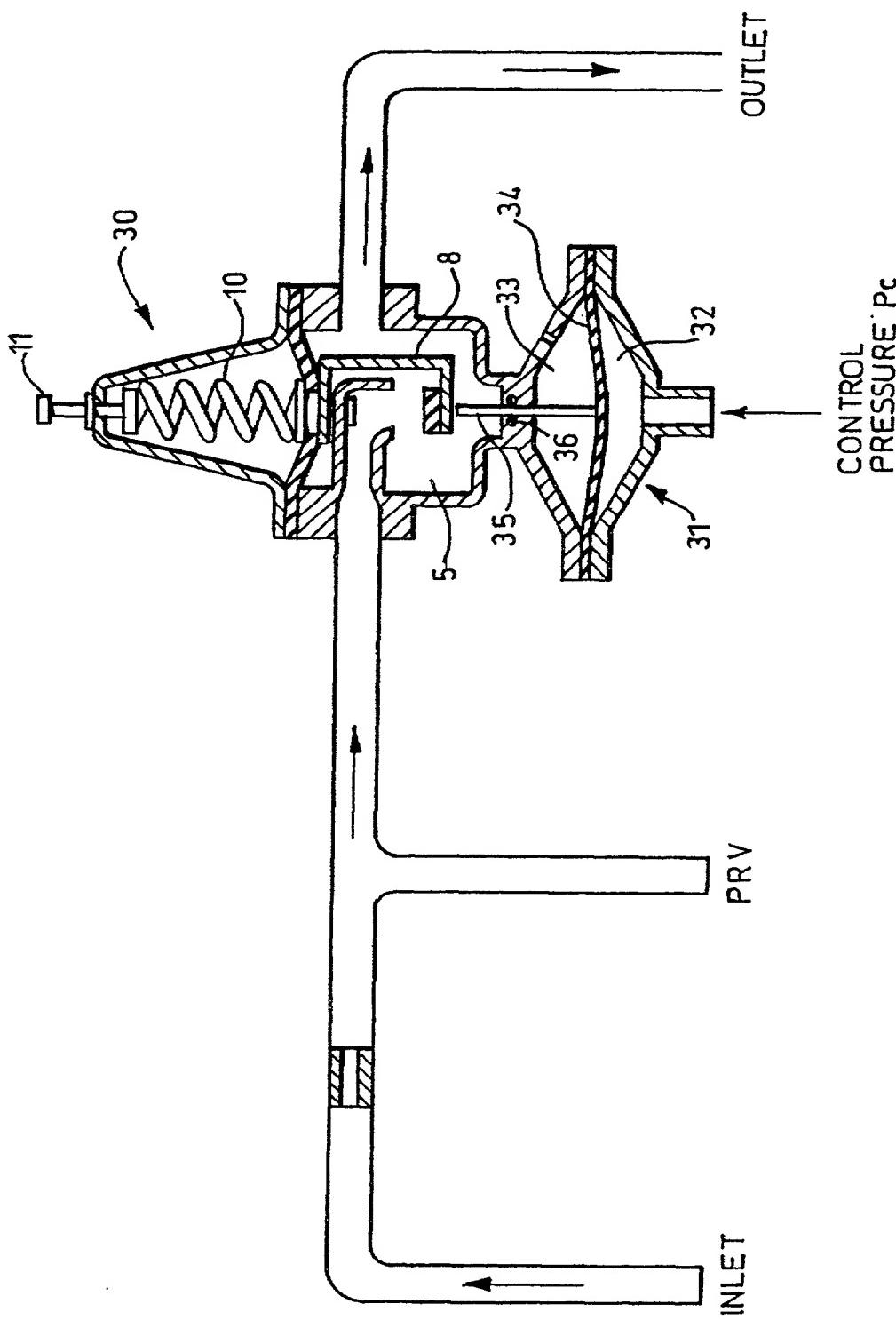


FIG.3.

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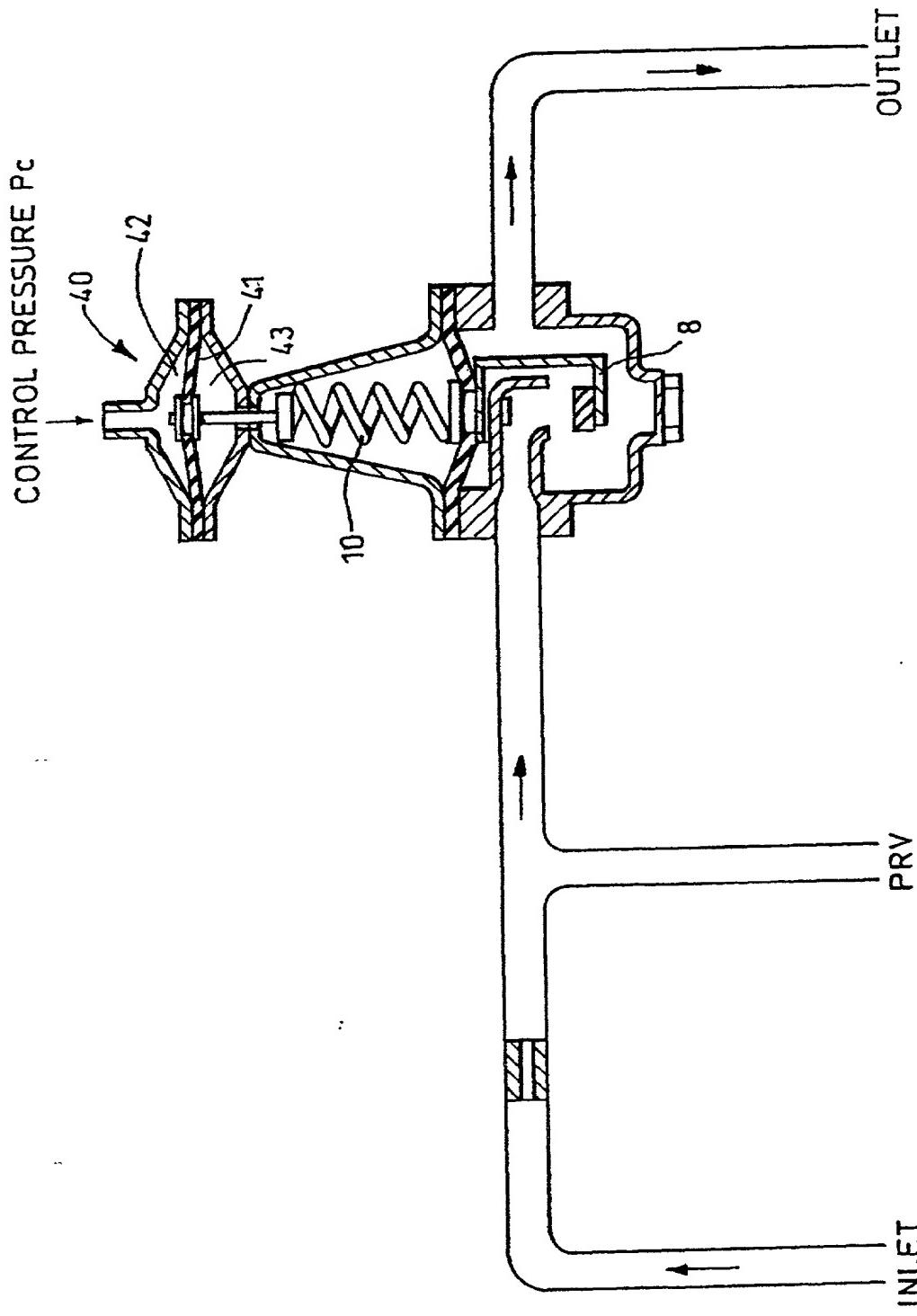


FIG.4.

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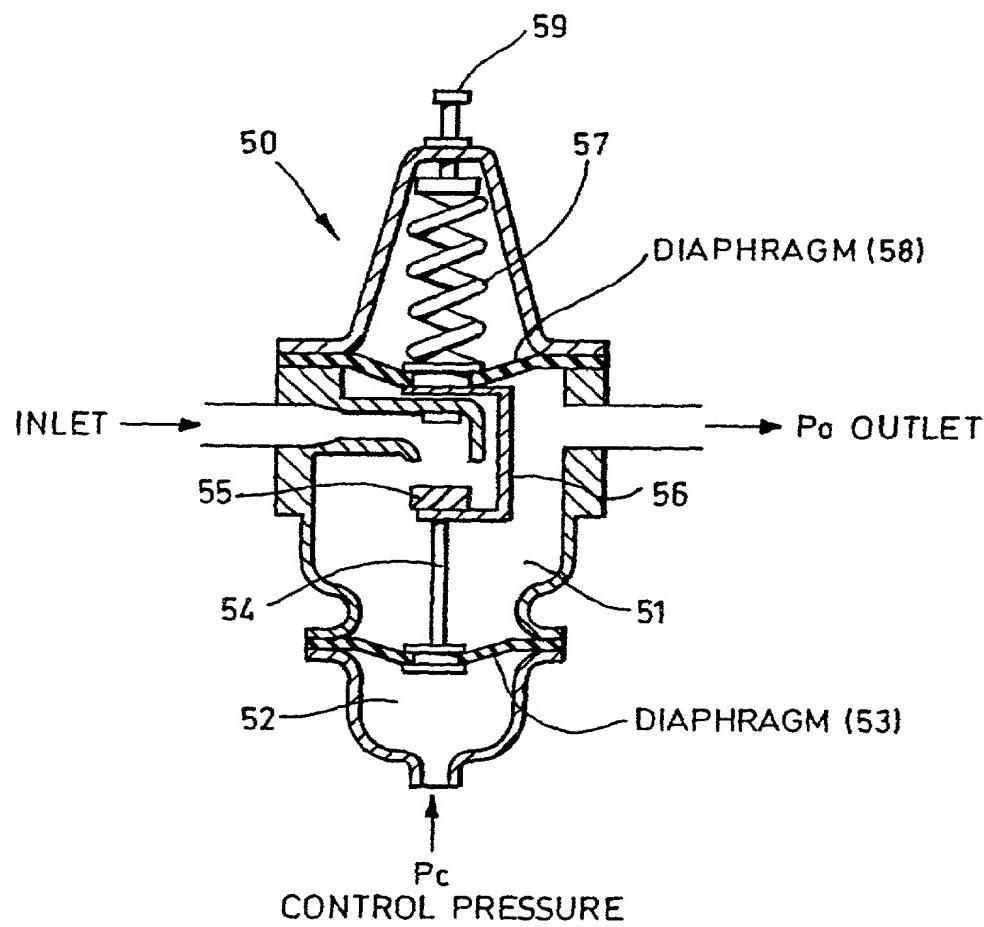


FIG.5.

**COMBINED DECLARATION AND POWER OF ATTORNEY**  
(Original, Design, National Stage Of PCT, Supplemental)

As the below named inventor, I hereby declare that:

This declaration is of the following type:

- original  
 design  
 national stage of PCT  
 supplemental

My residence, post office address and citizenship are as stated below next to my name, I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

**PILOT VALVE**

the specification of which:

- (a)  is attached hereto
- (b)  was filed on \_\_\_\_\_ as \_\_\_\_\_ or  Express Mail No., as Serial No. not yet known \_\_\_\_\_ and was amended by Preliminary amendment
- (c)  was described and claimed in PCT International Application No. PCT/GB00/02127 filed on 2 June 2000.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by the Preliminary Amendment attached hereto.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, Section 1.56(a).

- In compliance with this duty there is attached an information disclosure statement 37 CFR 1.97.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

- (d)  no such applications have been filed.
- (e)  such applications have been filed as follows:

COUNTRY	APPLICATION NUMBER	DATE OF FILING	PRIORITY CLAIMED <u>UNDER 37 USC 119</u>
PCT	<u>PCT/GB00/02127</u>	<u>02 June 2000</u>	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
GB	<u>9913058.5</u>	<u>04 June 1999</u>	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO

As the named inventors, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: Paul H. Johnson, Reg. No. 19,224

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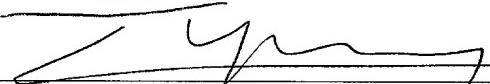
and/or Mark G. Kachigian Reg. No. 32,840 and/or Chad Hinrichs, Reg. No. 45,836 of the firm of HEAD, JOHNSON & KACHIGIAN 228 West 17th Place, Tulsa, Oklahoma 74119, Telephone Number (918) 587-2000, members of the Bar of the State of Oklahoma, and Robert R. Keegan, Reg. No. 18,614 of Head, Johnson & Kachigian, 112 West Center Street, Suite 230, Fayetteville, Arkansas, and Martin G. Ozinga, Reg. No. 44,992 of the firm of Head, Johnson & Kachigian, 204 North Robinson, Suite 3030, City Place Building, 30th Floor, Oklahoma City, Oklahoma 73102, Telephone Number (405) 236-4000, member of the Bar of the State of Oklahoma, to prosecute this application to register, to transact all business in the Patent and Trademark Office in connection therewith, and to receive the Letter Patent Document, if issued.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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